Montana Department of Environmental Quality

Water Protection Bureau
P.O. Box 200901
Helena, MT 59620-0901

PERMIT FACT SHEET

MONTANA GROUND WATER POLLUTION CONTROL SYSTEM (MGWPCS)

Permittee:	Fox Crossing Homeowner's Association
Permit Number:	MTX000149
Permit Type:	Domestic wastewater
Application Type:	Renewal
Facility Name:	Fox Crossing Subdivision
Facility Location:	Lewis and Clark County Lat 46.627932°, Long -111.897418° NE ¼, Section 18, Township 10 North, Range 2 West
Facility Address:	16 Fox Crossing Road, Helena, MT 59602
Facility Contact:	Darbee Lieburg, HOA President
Treatment Type:	Level II: Individual septic tanks for primary treatment followed by advanced treatment in a recirculating sand filter (RSF).
Receiving Water:	Class I Ground Water
Number of Outfalls:	1
Outfall / Type:	001 / pressure-dosed subsurface drainfield
Effluent Type:	Domestic strength wastewater
Mixing Zone:	Standard
Effluent Limit Type:	WQBEL
Final Effluent Limits:	Total nitrogen: 3.3 lbs/day
Flow Rate:	Design maximum capacity: 18,000 gpd Average daily flow: 5522 gpd (2017 DMR)
Effluent sampling:	Samples representative of effluent quality must be collected from the drainfield dose tank immediately prior to the drainfield dosing pumps
Ground water sampling:	MW 01 – quarterly, MW 02 – semi-annually
Fact Sheet Date:	09-07-2018
Prepared By:	Darryl Barton

1.0 PERMIT INFORMATION

DEQ issues Montana Ground Water Pollution Control System (MGWPCS) permits for a period of five years. The permit may be reissued at the end of the period, subject to reevaluation of the receiving water quality and permit limitations. This fact sheet provides the basis for DEQ's decision to renew a MGWPCS wastewater discharge permit to Darbee Lieburg, President, Fox Crossing Home Owners Association (HOA) for the FOX CROSSING SUBDIVISION wastewater treatment system. Contact information is found in **Appendix A**.

1.1 APPLICATION

DEQ received an application for renewal of the permit on 11-30-2015. Renewal fees accompanied the application. DEQ reviewed the submittal and issued a completeness letter on 12-11-2015.

1.2 PERMIT HISTORY

This is a permit renewal for a Montana Ground Water Pollution Control System (MGWPCS) discharge permit for the Fox Crossing Subdivision (FCS). The previous permit was issued to Tenneson Entities, Inc. on April 25, 2005, with an effective date of June 1, 2005. The permit was modified on April 25, 2005 and re-issued to reflect the change in the permittee to the Fox Crossing Homeowner's Association. The permit expired on May 31, 2010. The Department received a Form 1 and a GW-1 application with the renewal fee payment on October 8, 2010. The application was determined to be complete on November 30, 2010. Based on the permit renewal application, no new or increased source of pollutants is proposed.

FCS received a Certificate of Subdivision Plat Approval (EQ#04-1901) on July 30, 2004. Each lot has an individual drinking water well.

1.3 CHANGES TO THIS PERMIT

There is a change in the nitrogen limit from the previous permit. The new load limit was decreased from 3.9 pounds total nitrogen per day to **3.3 pounds** total nitrogen per day using actual ambient water quality from a monitoring well onsite.

2.0 FACILITY INFORMATION

2.1 LOCATION

The FOX CROSSING SUBDIVISION is located about 4 miles northeast of Helena **(Figure 1)**. The subdivision encompasses approximately 40 acres consisting of 59 single-family residential lots plus one lot that contains the wastewater treatment system. **(Figure 2)**. Population served is 148.

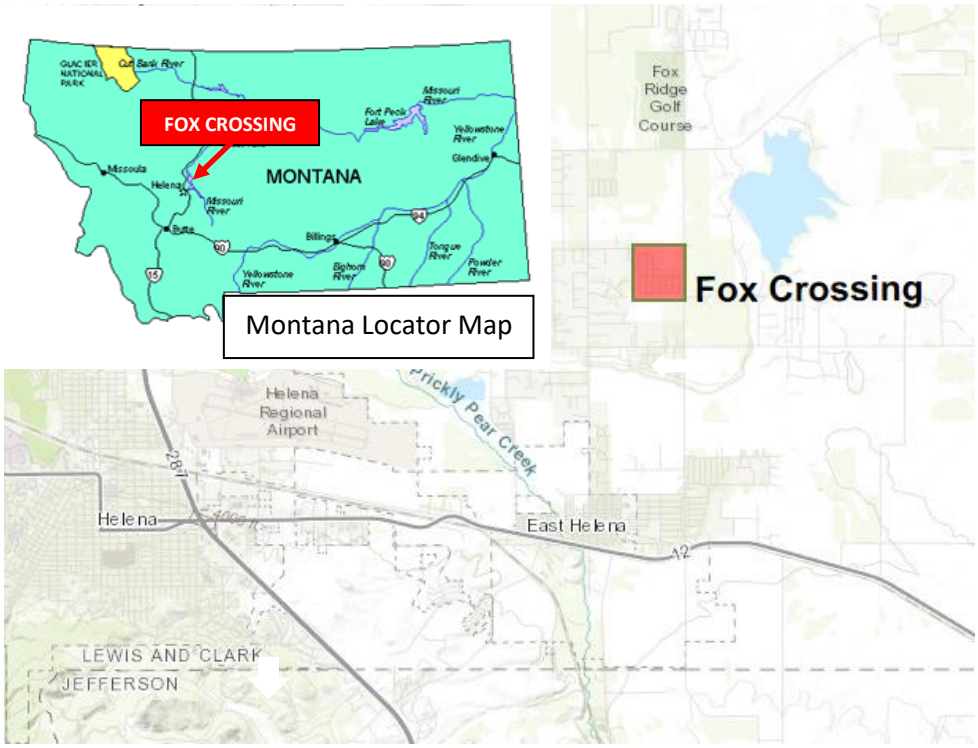


Figure 1. Location of the FOX CROSSING SUBDIVISION

Figure 2. FOX CROSSING WASTEWATER SYSTEM

2.2 OPERATIONS

System operations are summarized below in **Table 1**.

Table 1: Collection, Treatment, and Disposal System Summary
Inflows
Contributing Sources of Wastewater: Domestic In-Nature Standard Industrial Code(s) (SIC) of contributing sources: 4952 The number of connected residences: 59 single-family residences The number of connected business: 0
Influent Sampling Location: None
Influent Flow Monitoring Equipment: None
Treatment
Individual septic tanks for primary treatment followed by advanced treatment in a recirculating sand filter (RSF).
Treatment Level: Level 2
Location: 46.62833° Latitude and -111.89889° Longitude
Disposal System
Disposal Structure: Pressure-dosed subsurface drainfield (Outfall 001)
Method of Disposal: Infiltration to ground water
Location: 46.62833° Latitude and -111.89889° Longitude
Average Daily Design Flow (gpd): 17,700 Daily Maximum Design Flow (gpd): 18,000
Effluent Sampling Location: EFF-001: Effluent samples are taken from the dose tank
Flow Monitoring Equipment: M: 2 Flow meters are located between the dose tank and drainfield

Primary wastewater treatment begins in individual residence septic tanks (1,500-gallon) which provide anaerobic treatment as well as removing floatable and settleable solids. Each septic tank has an effluent filter on the outlet. Gravity-flow sewer collection lines (6-inch diameter, PVC) move the wastewater from the individual septic tanks to a lift-station where it is pumped into a 30,000-gallon (12-foot diameter, fiberglass) recirculating tank. A flow splitter provides a 4:1 ratio with four parts of the wastewater returning to the recirculation tank and one part being transferred to the dose tank prior to discharging to one of two subsurface drainfields. Most of the wastewater (four parts) is pressure-dosed from the recirculation tank into a recirculating sand filter (RSF) system, which provides Level 2 treatment. Prior to discharging to the drainfields, flow is measured using 2 totaling flow meters **(see Figure 3 – Flow Line-Diagram**). The maximum daily design flow from the wastewater system following primary and secondary treatment is 18,000 gpd.

Effluent permit limits were based on total nitrogen (TN), which consists of nitrate + nitrite, as N and total Kjeldahl nitrogen (TKN). The interim permit limit for TN was 26.1 mg/L (3.9 lbs/day) at the last point of control (the dose tank). Final effluent permit limit for TN was 24 mg/L (3.6 lbs/day) effective January 1, 2013. Therefore, the additional 7% nitrogen removal expected to occur within the subsurface drainfield will not be applied to the final TN effluent limit in the permit renewal at the last point of control.

Effluent samples over the previous permit cycle have been collected from the dose tank, analyzed, and reported to the Department on a quarterly basis. The permittee has collected grab effluent samples on a quarterly frequency at the drainfield dose tank over approximately a 7-year period (27 samples) as a requirement of the permit. The effluent analytical data is summarized in Table 2.

Monitoring and sampling requirements are further discussed in **Section 6**.

Appendix D is a **Wastewater System Operator Guide**, which highlights important aspects of the permit that apply to the operator.

Figure 3 is a line drawing of the collection, treatment, and disposal process.

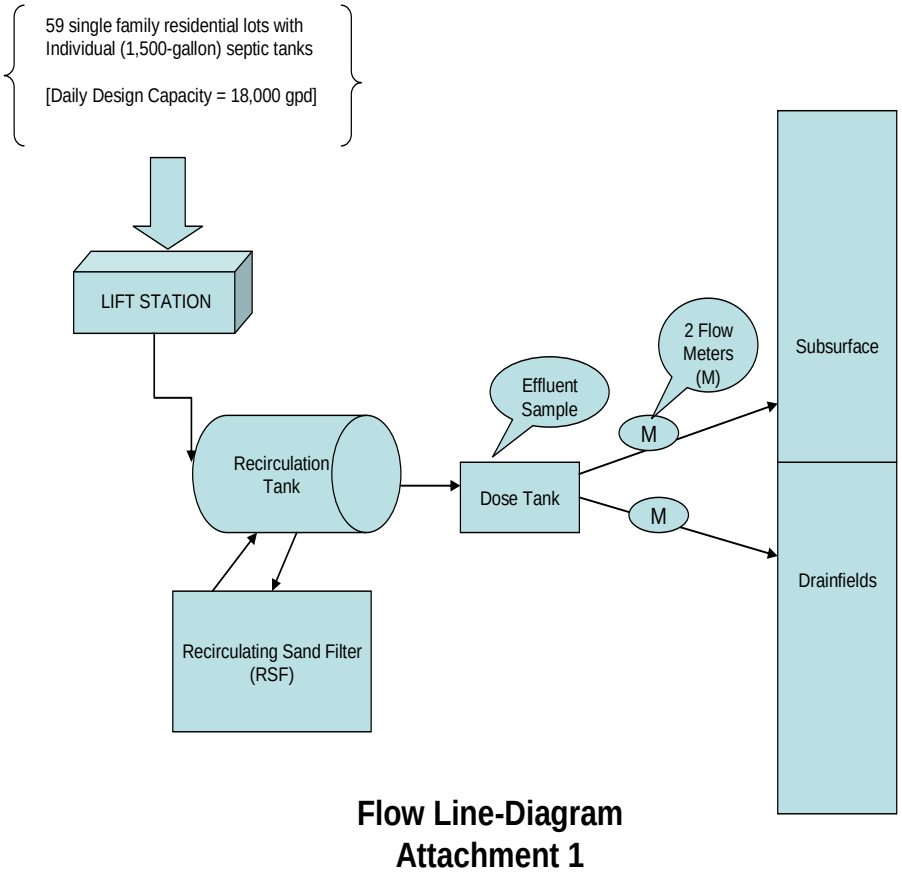


Figure 3. Wastewater Treatment System Line Diagram.

2.3 EFFLUENT CHARACTERISTICS

DEQ requires a permit applicant to disclose the quality of the effluent so DEQ may evaluate the potential for pollution of state water. During the previous permit cycle, the facility sampled and reported effluent quality criteria to DEQ in the form of discharge monitoring reports (DMRs). These data are summarized below in **Table 2**.

Most concentrations are reported in milligrams per liter (mg/L), which is equivalent to parts per million. Nitrogen and phosphorus load limits are measured in pounds per day (lbs/day).

3 of the last 4 quarterly samples exceeded total nitrogen in mg/L daily maximum concentration.
11 of the last 13 quarterly samples exceeded total nitrogen in mg/L daily maximum concentration.

However, only one quarterly sample has exceeded total nitrogen load limit in lbs/day since sampling began in 2011. Load limits are more appropriate for discharges to ground water since the long-term loading is the greater concern in absence of aquatic life considerations. Additionally, load limits inherently control both the strength and volume of the discharge.

Table 2. Effluent Quality Data from Outfall 001 (September 2011 – March 2018)

Parameter	Units	Reported DMR values			2011 Limit	# of Samples
		Minimum	Maximum	Average		
Flow rate	Gallons/day	4827	7633	6315	–	27
	Gallons/day (30-day average)	14,4810	228,990	189,450	–	27
BOD, 5-day	mg/L	3.2	49.2	12.96	–	27
Nitrogen, total Kjeldahl	mg/L	3.4	55.6	18.82	–	27
Nitrogen, total*	mg/L	11.7	74.2	30.17	24	27
	pounds/day	.366	4.41	1.579	–	27
Phosphorus, total	mg/L	3.39	8.96	5.392	–	27
	pounds/day	0.136	.416	0.295	–	27
Total suspended solids	mg/L	1	22	6.96	–	27

*Total Nitrogen = Nitrate + Nitrite + Total Kjeldahl Nitrogen (as N)

2.4 GEOLOGY

The Natural Resources Conservation Service (NRCS) Soil Survey indicates that soils consist of Attewan loam (NRCS, 2018) to 16 inches depth and loamy, gravelly sand to sandy gravel from 16 inches to 10 feet depth. Soil survey map from NRCS is found in **Appendix C.** The drainfield and associated mixing zone are installed in sandy gravelly loam to sandy gravel. Gravel content increases with depth. Slope ranges from 0 to 2%.

The geological conditions of the discharge site consist of sandy clay loam to 16 inches depth and loamy, gravelly sand to sandy gravel from 16 inches to 10-foot depth. The subsurface drainfield is constructed in the Quaternary valley-fill of the Helena Valley. Valley-fill material is best described as, “a sequence of complexly stratified lenses of cobble, gravel and sand with 30 to 70 percent of the section composed of intercalcated silt and clay. Lateral discontinuity of the many fine-grained layers allows hydraulic interconnection of the coarse-grained water-yielding zoned, which therefore function as one complex aquifer system” (USGS 1992).

2.5 HYDROGEOLOGY

Ground water is measured on well logs and data monitoring reports from test wells drilled on the property at 17 to 39 feet depth. Average depth to water is 19 feet measured in a monitoring well on the property from 2011 to 2018 (FXC-1). The separation from the base of the lateral trenches to the average depth to ground water in this area ranges from 15 to 26 feet depth.

Important hydrogeologic characteristics are summarized below in **Table 3**.

Table 3. Hydrogeologic Summary

Average depth to ground water	19 feet (MW FXC-1 static water level – per DMR)
General ground water flow direction	N36°W
Hydraulic conductivity	251.2 feet per day
Hydraulic gradient	0.003 feet/feet
Ambient groundwater nitrogen	3.3 mg/L (MW FXC-3)
Nearest downgradient surface water	Valley Driver Irrigation Canal (2,400 feet)

2.6 GROUND WATER MONITORING WELLS

There are 3 monitoring wells associated with this permit: FXC-1, FXC-2 and FXC-3. These wells are plotted on **Figure 2**. Monitoring well construction details are provided below in **Table 4**. FXC -1 is located 500-feet downgradient of the drainfield and measures water quality after the mixing zone. FXC-2 is just downgradient of the drainfield and measures water quality before the mixing zone. FXC-3 is an upgradient well that is used to measure ambient water quality.

Table 4. Monitoring Well Summary

Monitoring Well FXC-1	
Location:	Latitude: 46.62825° Longitude: -111.89928°
Rationale:	Ground water quality at the end of the mixing zone
Notes:	500-feet downgradient of drainfield (Northwest)
Monitoring Well FXC-2	
Location:	Latitude: 46.62913° Longitude: -111.89929°
Rationale:	Mixing zone water quality
Notes:	100-Feet downgradient of drainfield within the mixing zone (Northwest)
Monitoring Well FXC-3	
Location:	Latitude: 46.62460° Longitude: -111.89622°
Rationale:	Upgradient / Ambient receiving water quality
Notes:	South of intersection of Lilac Drive and Sly Road

If a DEQ-approved monitoring well is abandoned, destroyed or decommissioned, or is no longer able to be sampled due to fluctuations in the ground water table, the permittee must install or designate a new well to replace the abandoned, destroyed, decommissioned, or non-viable well.

2.7 GROUND WATER QUALITY CHARACTERISTICS

Water sampling results are provided below in **Table 5**. Based on the 642 microsiemens per centimeter (µS/cm) specific conductance, the receiving water is Class I ground water.

Monitoring well FXC-2 was established as a fecal coliform monitoring well to test drainfield effectiveness. There have been no fecal coliforms detected in FXC-2.

Ambient water quality was measured using monitoring well FXC-3. Sampling from 2014 and 2015 was reported at an average of 3.3 mg/L nitrate + nitrite (as N).

Table 5. Summary of Ground Water Characteristics at Monitoring Well, FXC-1

Parameter, units	Average Value	Minimum Value	Maximum Value	Number of Samples
Specific Conductance, µmhos/cm	642	610	715	4
Chloride, mg/L	26.4	12	68	19
Fecal Coliform, organisms/100ml	<1	<1	<1	19
Nitrate + Nitrite (as N), mg/L	8.7	2.2	13.9	19
Total Suspended Solids (TSS), mg/L	7.5	<1	27	19

Monitoring period: January 1, 2006 through September 30, 2010

3.0 WATER QUALITY STANDARDS AND NONDEGRADATION

Ground water is a water of the state. The State of Montana uses several water quality measures to protect, sustain, and improve the quality of state waters. These water quality limitations provide the basis for effluent limits that DEQ applies to discharge permits (**Section 5**). DEQ protects all designated uses of state water by basing effluent limits on the most restrictive water quality limitations, intended to protect the most sensitive uses.

3.1 BENEFICIAL USES

With a specific conductivity of 642 µS/cm (**Table 4** above), the receiving water is Class I ground water and therefore a high-quality water of the State. Class I ground waters must be maintained suitable for the following uses with little or no treatment:

- Public and private drinking water supplies
- Culinary and food processing purposes
- Irrigation
- Drinking water for livestock and wildlife
- Commercial and industrial purposes

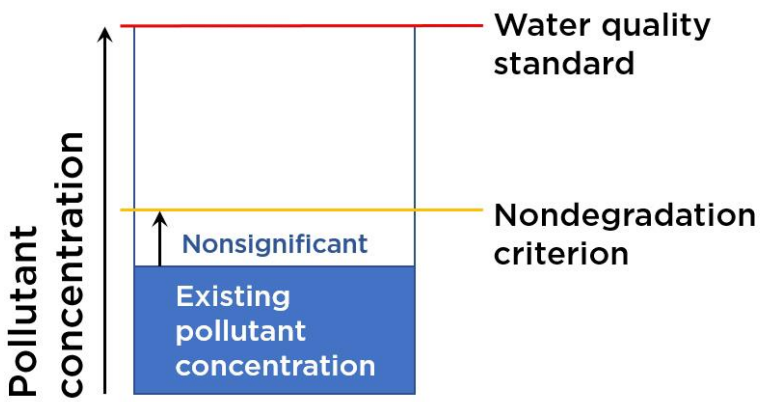
DEQ protects all the assigned beneficial uses by protecting the most sensitive. Drinking water is the most sensitive use of this receiving water.

3.2 WATER QUALITY STANDARDS

DEQ's ground water standard for nitrate is 10.0 mg/L, as is the standard for nitrate + nitrite (as nitrogen). Class I ground water must be maintained suitable for use as a drinking water supply with little or no treatment, and therefore must meet the corresponding human health standard of 10.0 mg/L total nitrogen. These water quality standards may not be exceeded outside a designated mixing zone (**Section 4**).

3.3 NONDEGRADATION

Montana's nondegradation policy is intended to preserve high-quality state waters. Any water whose existing condition is better than the water quality standards must be maintained in that high quality. Nondegradation policy states that certain types of common activities cause nonsignificant changes in water quality, and provides criteria for determining whether changes in water quality are significant.



Nonsignificant changes do not require further nondegradation review. Therefore, DEQ must determine whether the proposed discharge will result in significant changes in water quality.

3.4 NONSIGNIFICANCE

When developing the initial permit (2011), DEQ determined that discharges in compliance with this permit result in nonsignificant changes in water quality. This discharge has not increased since this determination, and therefore DEQ did not perform a new significance determination for this permit renewal. DEQ determined that the discharge continues to meet ground water nonsignificance/nondegradation criteria (described below) at the end of the mixing zone (**Section 4**). DEQ used these criteria and updated ground water quality data to establish effluent limits (discussed below in **Section 5**).

For this discharge to ground water, the following nonsignificance criteria are relevant:

Nitrogen

Under Montana statute, ground water total nitrogen at or below 7.5 mg/L at the downgradient end of the mixing zone (see **Section 4**) is a nonsignificant change in water quality, so long as the discharge does not cause degradation of surface water. Evaluation of the effects to surface water are discussed below in **Section 3.4.2**. Using the nonsignificance criterion of 7.5 mg/L, DEQ established effluent limits that cause the discharge to comply with ground water nonsignificance/nondegradation criteria at the end of the mixing zone. This is discussed in detail in **Section 5.1**.

Phosphorus

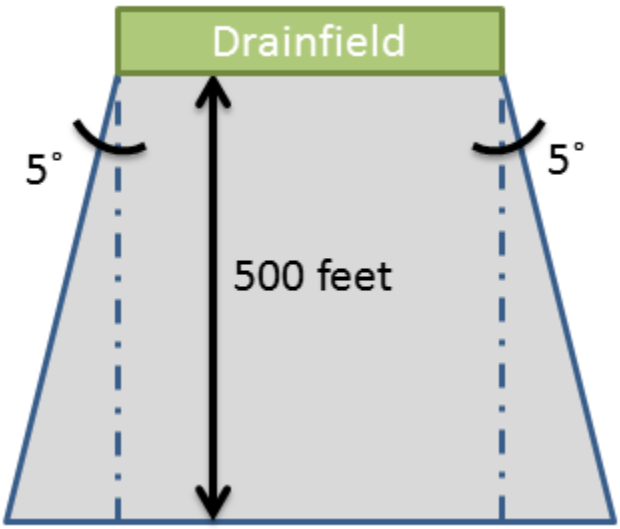
A total phosphorus (TP) surface water breakthrough time of greater than 50 years is a nonsignificant change in water quality. The phosphorus criterion requires an analysis to determine a breakthrough time. Breakthrough occurs when the subsurface soils lose their capability to adsorb phosphorus, and it reaches surface water.

A phosphorus breakthrough analysis conducted by DEQ in 2011 estimated the phosphorus breakthrough to occur in over 123 years. Phosphorus breakthrough time of greater than 50 years is considered nonsignificant. The 2011 permit established an effluent limit to maintain the 50-year breakthrough. This 2011 effluent limitation is maintained within this proposed permit renewal. Based on the N36°W shallow ground water flow direction at this site, the phosphorous breakthrough analysis calculated for the previous permit shows the breakthrough time to the nearest surface water (Valley Drive Irrigation Canal) from Outfall 001 is over 123 years.

4.0 MIXING ZONE

A mixing zone is a specifically defined area of the receiving water where water quality standards may be exceeded. DEQ evaluates the suitability according to criteria established in the Administrative Rules of Montana. The mixing zone is then defined in the permit. The applicant requested a standard mixing zone for this discharge, consistent with previous permit cycles.

A standard mixing zone extends 500 feet downgradient from the source. The upgradient boundary is equal to the width of the source (measured perpendicular to the of ground water flow direction). The mixing zone widens in the downgradient direction by 5° on either side. The width of the downgradient boundary is calculated by adding the increased width for each side (the tangent of 5° (0.0875) times the mixing zone length) to the width of the upgradient boundary. Standard mixing zones extend 15 feet below the ground water table.



The volume of ground water (Q_{GW}) available to mix with the effluent is calculated using Darcy's Equation: $Q_{GW} = KIA$

Where:
Q_{GW} = ground water flow volume (feet^3/day)
K = hydraulic conductivity (feet/day)
I = hydraulic gradient (feet/feet)
A = cross-sectional area (feet^2) at the downgradient boundary of the mixing zone.

Table 6 summarizes the variables used in Darcy's equation and the resulting volume of ground water available to mix at Outfall 001. These values are drawn from the previous statement of basis (2011).

Table 6. Mixing Zone for Total Nitrogen Discharged from Outfall 001

Parameter	Units	Value
Receiving water nitrogen concentration	3.3	mg/L
Ground water flow direction	N36°W	Bearing
Length of mixing zone	500	Feet
Depth of mixing zone	15	Feet
Upgradient width of mixing zone	631	Feet
Downgradient width of mixing zone	718	Feet
Cross-sectional area of mixing zone (A)	10,783.5	Square feet
Hydraulic conductivity (K)	251.2	Feet per day
Hydraulic gradient (I)	0.003	Feet per feet
Volume of ground water available for mixing (Q_{GW})	8,126	Cubic feet per day

To determine whether a mixing zone is allowable, DEQ calculates a predicted concentration at the downgradient end of the mixing zone. This mixing calculation follows the following procedure:

- Volume of ground water times the concentration of the parameter = existing load;
- Volume of discharge times the concentration of the parameter = waste load; and
- (Existing load + waste load) / total volume = predicted concentration.

Because the predicted concentration must satisfy the most stringent nonsignificance criterion (**Section 3**), DEQ can calculate water quality based effluent limits (WQBELs) by rearranging the equation and solving for the effluent concentration (**Section 5**).

5.0 PERMIT CONDITIONS

Discharge permits include conditions that ensure compliance with the Montana Water Quality Act and the regulations used to implement it. These conditions include effluent limits as well as any special conditions that DEQ deems necessary to protect the quality of the receiving water.

Montana's numeric water quality standards are published in Circular DEQ-7. Water quality criteria applicable to this permit are summarized below in **Table 7**. The permit establishes effluent limits that will meet water quality standards and nondegradation criteria, thereby protecting beneficial uses and existing high-quality waters. The most restrictive criteria in **Table 7** provide the basis for the effluent limits.

Table 7. Applicable Ground Water Quality Criteria

Parameter	Human Health Standard	Beneficial Use Support	Nondegradation Criteria
Nitrate plus nitrite (as Nitrogen[N])	10 mg/L	-	-
Total Nitrogen	-	10 mg/L	**7.5 mg/L**
Total Phosphorus	-	-	**>50-year breakthrough**

This discharge permit includes numeric WQBELs that restrict the strength and volume of the discharge. The ground water nonsignificance criteria (**Section 3.4.1**) provide the basis for the limits. DEQ calculates WQBELs by rearranging the mixing zone equation (**Section 4**) and solving for the effluent concentration that satisfies the water quality criteria. DEQ evaluates and recalculates the limits using updated water quality data as part of every permit renewal cycle. In this way, DEQ protects the receiving water quality by continually assessing cumulative impacts to the receiving water. DEQ calculated the effluent limits using the same method as for the previous permit. DEQ used updated ambient ground water quality data to re-evaluate the receiving water quality and the assimilative capacity for dilution.

5.1 TOTAL NITROGEN EFFLUENT LIMIT

The nonsignificance criterion of 7.5 mg/L is the most restrictive of the water quality criteria applicable to this permit; therefore, it is the water quality target for this effluent limit. DEQ established the final WQBEL for this discharge in the previous permit by back-calculating the effluent concentration that results in 7.5 mg/L at the end of the mixing zone, given the available dilution. Available dilution is determined by recent ground water quality sampling of the receiving water. Ambient total nitrogen averaged **3.3 mg/L** (**Section 2**). DEQ calculated an effluent limit of **22 mg/L**. 22 mg/L is the final WQBEL expressed as a concentration. Load limits are more appropriate for discharges to ground water since the long-term loading is the greater concern in absence of aquatic life considerations. Additionally, load limits inherently control both the strength and volume of the discharge. A discharge of **18,000 gpd** containing **22 mg/L** total nitrogen is equivalent to **3.3 pounds per day**. The detailed limit calculations are provided in detail in **Appendix B**.

Table 8. Water Quality-Based Effluent Limits for Outfall 001

Parameter	Daily Maximum (lbs/day) [2]
Total nitrogen, as N (TN)[1]	3.3

(1) Total nitrogen (TN) is the sum of nitrate + nitrite (as N) and total Kjeldahl nitrogen (as N).

(2) Load (lbs/day) = flow (gpd) x concentration (mg/L) x 8.34×10^{-6}

6.0 MONITORING AND REPORTING REQUIREMENTS

DEQ requires effluent and ground water monitoring to assure compliance with the effluent limitations and therefore water quality standards. Effluent monitoring and ground water monitoring is required as a condition of this permit. All monitoring and sampling required by this permit must be representative; therefore, the permit identifies specific monitoring locations. Monitoring requirements and rationale are summarized below.

6.1 EFFLUENT MONITORING

This permit includes numeric effluent limitations with specific magnitudes and durations to ensure the discharge will not cause or contribute to an exceedance of an applicable water quality standard (see **Section 3**). Accordingly, the permittee is required to monitor and report at a specified frequency to demonstrate compliance with these limitations.

Effluent samples and discharge flow measurements must be representative of the nature and volume of the effluent. The effluent sample location (EFF-01) is located at the dose tank as shown in **Figure 3**. The permittee is required to install, maintain and report flow measurements using a flow-measuring device capable of measurements that are within 10 percent of the actual flow. 2 flow meters are used to measure effluent flow. The flow meters (M) are located between the dose tank and subsurface drainfields (**Figure 3**).

Effluent monitoring and reporting requirements are summarized in **Table 9** below. All analytical methods must be in accordance with the Code of Federal Regulations, 40 CFR Part 136 for each monitored parameter.

Table 9. Effluent Monitoring and Reporting Requirements – Outfall 001

Parameter	Units	Sample Type	Minimum Sample Frequency	Reporting Requirements	Reporting Frequency	Rationale
Effluent Flow Rate	gpd	Continuous	Continuous	Daily Maximum(5)	Quarterly	Effluent Characterization
				Quarterly Average		
Total Nitrogen, as N (TN)	mg/L	Calculate(1)	1/Quarter	Daily Maximum	Quarterly	Permit Compliance
	lbs/day	Calculate(2)	1/Quarter	Daily Maximum(5)		
Total Kjeldahl Nitrogen	mg/L	Grab	1/Quarter	Daily Maximum	Quarterly	Effluent Characterization
Nitrate+Nitrite (as N)	mg/L	Grab	1/Quarter	Daily Maximum	Quarterly	
Total Phosphorus (as P)(6)	mg/L	Grab	1/Quarter	Quarterly Average	Quarterly	Effluent Characterization

(1) Calculate TN: TN (mg/L) = nitrate + nitrite, as N (mg/L), plus total Kjeldahl nitrogen (mg/L).
(2) Calculate Load: lbs/day = concentration (mg/L) x flow (gpd) x [8.34 x 10^{-6}].
(3) Calculate Load: lbs/year = sum quarterly loads (lbs/day) for the calendar year.
(4) Annual maximum load shall be reported on an annual basis (due January 28 each year of the permit cycle).
(5) Report highest (maximum) measured daily concentration for each quarterly reporting period on the DMR.

6.2 GROUND WATER MONITORING

Ground water monitoring includes both water quality sampling and water level monitoring. Ground water monitoring was established by the previous permit (2011) and will continue. Monitoring is intended to check if the system is operating properly and remaining in compliance.

This permit requires ground water monitoring to provide long term ambient and downgradient characterization of the aquifer. Ground water monitoring will be required at monitoring wells FXC-1 and FXC-2. Data collected via ground water monitoring is used for mixing zone evaluation and aquifer characterization.

Ground water monitoring and reporting requirements are summarized in **Table 10** below. All analytical methods must be in accordance with the Code of Federal Regulations, 40 CFR Part 136 for each monitored parameter.

Table 10. Ground Water Monitoring Requirements

Parameter, units	Location	Minimum Sample Frequency	Sample Type	Reporting Frequency	Reporting Requirements
Static Water Level (SWL), ft below top of casing	FXC-1	1/Quarter	Instantaneous	Quarterly	Quarterly Average
Specific Conductivity µmhos @ 25°C	FXC-1	1/Quarter	Grab	Quarterly	Quarterly Average
Nitrate + Nitrite (as N), mg/L	FXC-1	1/Quarter	Grab	Quarterly	Daily Maximum
Escherichia Coli, <1 CFU/100mL	FXC-2	1/Semi-annual	Grab	Semi-annually	Daily Maximum
Static Water Level (SWL), ft below top of casing	FXC-3	1/Quarter	Instantaneous	Quarterly	Quarterly Average
Nitrate + Nitrite (as N), mg/L	FXC-3	1/Quarter	Grab	Quarterly	Daily Maximum
Chloride (as Cl), mg/L	FXC-3	1/Quarter	Grab	Quarterly	Quarterly Average

7.0 PUBLIC NOTICE

Legal notice information for water quality discharge permits are listed at the following website: http://deq.mt.gov/Public/notices/wqnotices. Public comments on this proposal are invited any time prior to close of business on October 10, 2018 . Comments may be directed to:

DEQWPBPublicComments@mt.gov

or to:

Montana Department of Environmental Quality
Water Protection Bureau
PO Box 200901
Helena, MT 59620

All comments received or postmarked prior to the close of the public comment period will be considered in the formulation of the final permit. DEQ will respond to all substantive comments pertinent to this permitting action and may issue a final decision within thirty days of the close of the public comment period.

All persons, including the applicant, who believe any condition of the draft permit is inappropriate, or that DEQ's tentative decision to deny an application, terminate a permit, or prepare a draft permit is inappropriate, shall raise all reasonably ascertainable issues and submit all reasonably available arguments supporting their position by the close of the public comment period (including any public hearing). All public comments received for this draft permit will be included in the administrative record and will be available for public viewing during normal business hours.

Copies of the public notice are mailed to the applicant, state and federal agencies, and interested persons who have expressed interest in being notified of permit actions. A copy of the distribution list is available in the administrative record for this draft permit. Electronic copies of the public notice, draft permit, fact sheet, and draft environmental assessment are available at the following website: http://deq.mt.gov/Public/notices/wqnotices.

Any person interested in being placed on the mailing list for information regarding this permit may contact the DEQ Water Protection Bureau at (406) 444-3080 or email DEQWPBPublicComments@mt.gov. All inquiries will need to reference the permit number (MTX000149), and include the following information: name, address, and phone number.

During the public comment period provided by the notice, DEQ will accept requests for a public hearing. A request for a public hearing must be in writing and must state the nature of the issue proposed to be raised in the hearing.

8.0 References:

40 CFR § 136 – Guidelines Establishing Test Procedures for the Analysis of Pollutants. 2017.

Administrative Rules of Montana, Title 17, Chapter 30, Water Quality:
- Subchapter 2 - Water Quality Permit Fees.
- Subchapter 5 – Mixing Zones in Surface and Ground Water.
- Subchapter 7 – Nondegradation of Water Quality.
- Subchapter 10 – Montana Ground Water Pollution Control System.
- Subchapter 13 – Montana Pollutant Discharge Elimination System.

Aqua Bona Consulting, Aquifer Pump Test, August 27, 2004.

Department of Environmental Quality. 2005. Administrative Record of Montana Ground Water Pollution Control System (MGWPCS) permit application and supplemental materials, Tenneson Entities, Inc. / Fox Crossing Subdivision, MTX000149.

Department of Environmental Quality. 2012. Administrative Record of Montana Ground Water Pollution Control System (MGWPCS) permit application and supplemental materials, Fox Crossing Homeowner's Association / Fox Crossing Subdivision, MTX000149.

Department of Environmental Quality. 2016. Administrative Record of Montana Ground Water Pollution Control System (MGWPCS) permit application and supplemental materials, Turah Meadows County Sewer and Water District, MTX000146.

Department of Environmental Quality, Water Quality Circulars:
- Circular DEQ-2 – Design Standards for Wastewater Facilities.
- Circular DEQ-4 – Montana Standards for On-Site Subsurface Sewage Treatment Systems.
- Circular DEQ-7 – Montana Numeric Water Quality Standards.

Department of Environmental Quality, "How to Perform a Nondegradation Analysis for Subsurface Wastewater Treatment Systems (SWTS), October 2015.

Driscoll, F.G., 1986. Groundwater and Wells (2nd ed.), Johnson Filtration Systems, Inc., St. Paul, Minnesota.

Fetter, C.W., 2001. Applied Hydrogeology (4th ed.), Prentice-Hall, Upper Saddle River, New Jersey.

Freeze, R.A. and J.A. Cherry, 1979. Groundwater, Prentice Hall, Englewood Cliffs, New Jersey.

Kendy, E. and R.E. Tresch. 1996. Geographic, Geologic, and Hydrologic Summaries of Intermontane Basins of the Northern Rocky Mountains, Montana. USGS Water-Resources Investigations Report: 96-4025.

Montana Bureau of Mines and Geology, Ground Water Information Center (GWIC), July 2018, http://mbmggwic.mtech.edu

Montana Code Annotated, Title 75, Chapter 5, Montana Water Quality Act, 2017.

NRCS, Soil Survey (Web), Lewis and Clark County, https://websoilsurvey.nrcs.usda.gov/app/.

NRCS, Soil Survey, Lewis and Clark County. 2003.

Stahly Engineering and Associates, “Fox Crossing: Supplemental Information” including: Engineering Report, Operation and Maintenance Plan and subdivision significance determination, May 28, 2004.

U.S. Department of Agriculture, Natural Resources Conservation Service. 2015. National Cooperative Soil Survey. Retrieved from http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm, May 2015.

U.S. Environmental Protection Agency, Effluent Limitation Guidelines, http://water.epa.gov/scitech/wastetech/guide/, 2013.

U.S. Environmental Protection Agency, Guidance Manual for Developing Best Management Practices <http://www.epa.gov/npdes/pubs/owm0274.pdf>, 1993.

U.S. Environmental Protection Agency, NPDES Permit Writers’ Manual, 833-K-10-001, September 2010.

U.S. Environmental Protection Agency, Nitrification, 625/R-00/008, Office of Ground Water and Office of Water. 2002.

U.S. Environmental Protection Agency, Onsite Wastewater Treatment Systems Manual, 625/R-00/008, Office of Research and Development and Office of Water. 2002.

Appendix A – Fox Crossing Contacts (2018):

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APPENDIX B – EFFLUENT LIMIT CALCULATIONS

The allowable discharge concentration is derived from the mass balance water quality equation [ARM 17.30.517(1)(d)], which considers dilution and the background concentration of the receiving water (EPA, 2002).

In accordance with ARM 17.30.517(1)(d)(i), the volume of ground water available at this site for mixing is calculated using Darcy's equation,

$$Q = KIA$$

Where: Q = ground water flow volume (ft^3/day)
K = hydraulic conductivity (ft/day)
I = hydraulic gradient (ft/ft)
A = cross-sectional area (ft^2) of flow at the hydraulically downgradient boundary of the 500-foot standard mixing zone

$$Q = 8{,}126\ ft^3/day$$

$$Q = 251.2\ ft/day \times 0.0027\ ft/ft \times 10{,}783.5\ ft^2$$

The hydraulic conductivity (K) is 251.2 ft/day based on the 24-hour shallow aquifer pump test conducted on test well #1 located in the northwest corner of the property. The shape of the mixing zone is determined using the dimensions of that subsurface drainfield and information on water table elevations and topography. The width of the drainfield, perpendicular to the direction of ground water flow is 631 feet plus the tangent of 5° on both sides of the mixing zone according to ARM 17.30.517(1)(d)(iii)(B). The depth of the mixing zone (standard) is 15 feet applying the direct interpretation of ARM 17.30.517(1)(d)(iii)(A). Shallow ground water gradient is 0.0027 ft/ft, which has been rounded to 0.003 ft/ft.

The permit renewal will maintain the standard 500-foot ground water mixing zone for an individual parameter of nitrate + nitrite (as N) according to ARM 17.30.505(1)(a).

The nondegradation review for nitrate + nitrite (as N) remains as provided in the previous permit. For the permit renewal, the allowable discharge concentration from the dose tank prior to discharge to the subsurface drainfield (Outfall 001) remains as:

$$C_2 = \frac{C_3(Q_1 + Q_2) - C_1 Q_1}{Q_2}$$

C_2 = 22 mg/L

C_1 = ambient ground water (baseline) concentration, is 3.3 mg/L
C_2 = allowable discharge concentration (TN) at the dose tank prior to discharging to the subsurface drainfield in mg/L
C_3 = ground water concentration limit for pollutant (DEQ Circular 7) at the end of the standard mixing zone is 7.5 mg/L
Q_1 = ground water volume is 8,126 ft^3 /day
Q_2 = maximum flow of discharge (daily design capacity is 2,406 ft^3 /day)

The daily design capacity of the wastewater disposal system is 18,000 gpd or 2,406 ft^3/day. The ambient concentration of nitrate + nitrite (as N) in the shallow ground water is 3.3 mg/l (C_1). It is assumed that the entire TN load in the effluent converts to nitrate (as N) and enters the ground water. The TN reduction of 7 percent (DEQ, March 2005), which was acknowledged to occur naturally beneath the drainfield in the previous permit is no longer applicable [refer to ARM 17.30.517(1)(d)(v)] in the final permit renewal effluent limits.

The calculated water quality-based effluent concentration of TN must not exceed 22 mg/L at the daily design flow to maintain a concentration that is less than the nondegradation-based criteria of 7.5 mg/L for nitrate plus nitrite (as N) in the ground water at the mixing zone boundary. The WQBEL will be expressed as a load (lbs/day) [ARM 17.30.517(1)(d)(vi)(B)] based on the daily design flow of the system (18,000 gpd) and the calculated maximum concentration as follows:

Load limit (lbs/day) per outfall =effluent flow rate (gpd) x daily maximum concentration (mg/L) ***x*** *(8.34 x* 10^{-6}*)*
Load limit (lbs/day) per outfall= (18,000 gpd) **x** (22 mg/L) **x** (8.34 x 10^{-6})
L**oad limit (lbs/day) per outfall= 3.3 lbs/day**

The WQBELs are summarized in Table 8 for Outfall 001.

Appendix C – Fox Crossing Soils Survey Map – NRCS:

Natural Resources Conservation Service (NRCS)

https://websoilsurvey.nrcs.usda.gov/app/

Map Unit Legend

Lewis and Clark County Area, Montana (MT630)

Lewis and Clark County Area, Montana (MT630)

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
1B	Aridic Ustifluvents, channeled, 0 to 4 percent slopes	7.0	2.6%
406A	Nippt gravelly loam, 0 to 2 percent slopes	111.3	41.4%
413A	Attewan loam, 0 to 2 percent slopes	149.1	55.4%
513A	Attewan-Nippt complex, 0 to 2 percent slopes	1.6	0.6%
Totals for Area of Interest		**269.0**	**100.0%**

Appendix D – Wastewater System Operator Guide

This document is meant to serve as a guide to the operator of the wastewater system. It highlights the important aspects of the permit that apply to the operator.

1. Effluent limits

Table 8. Final Numeric Effluent Limits – Outfall 001.

Parameter	Units	Daily Maximum(1)	Annual Maximum(1)
Total Nitrogen – Load(2)	lbs/day	**3.3**	NA

Footnotes:
(1) See definitions, Part I.A of the permit
(2) Load calculation: lb/d = [(mg/L) x flow (gpd) x (8.34×10^{-6})]
(3) Detailed Load calculations are found in Appendix B

2. Violations

Over the past three years the only violations related to this facility are nitrogen concentration in the effluent. The current permit will not have effluent concentration limits for nitrogen. However, the system must maintain total nitrogen load **below 3.3 lbs/day**. Load limits are more appropriate for discharges to ground water since the long-term loading is the greater concern in absence of aquatic life considerations. Additionally, load limits inherently control both the strength and volume of the discharge.

3. Changes to this Permit

There is a change in the nitrogen limit from the previous permit. New load limit is 3.3 pounds total nitrogen per day. Effluent limit justification is found in Section 5.1. Previous effluent limit of 3.9 lbs/day total nitrogen was calculated without onsite water quality information. The current effluent limit was calculated using actual ambient water quality from a monitoring well onsite. Effluent limit calculations are found in Appendix B.

Monitoring of ambient / upgradient groundwater will be reestablished from monitoring well FXC-3. There have been high nitrogen levels periodically in the groundwater in your area. By sampling quarterly from FXC-3 we can better establish if nitrogen is coming from upstream rather than from your system. Chloride will also be sampled at FXC-3 to better understand the source of nitrogen. Ground water sampling requirements are found in Table 10.

4. Effluent Monitoring and Reporting Requirements – Outfall 001

Parameter	Units	Sample Type	Minimum Sample Frequency	Reporting Requirements	Reporting Frequency	Rationale
Effluent Flow Rate	gpd	Continuous	Continuous	Daily Maximum[5]	Quarterly	Proper O & M
				Quarterly Average		
Total Nitrogen, as N (TN)	mg/L	Calculate[1]	1/quarter	Daily Maximum	Quarterly	Permit Compliance for Level 2 Treatment ARM 17.30.702(11)
	lbs/day	Calculate[2]	1/quarter	Daily Maximum[5]		
Total Kjeldahl Nitrogen	mg/L	Grab	1/quarter	Daily Maximum	Quarterly	Permit compliance for TN
Nitrate+Nitrite (as N)	mg/L	Grab	1/quarter	Daily Maximum	Quarterly	
Total Phosphorus (as P)[6]	mg/L	Grab	1/quarter	Quarterly Average	Quarterly	Permit compliance for Nondegradation ARM 17.30.715 (1)(e)
	lbs/day	Calculate[2]	1/quarter	Quarterly Average		
	lbs/year	Calculate[3]	1/year	Annual Maximum[4]		

5. Ground Water Monitoring Requirements

Parameter, units	Location	Minimum Sample Frequency	Sample Type	Reporting Frequency	Reporting Requirements
Static Water Level (SWL), ft below top of casing	FXC-1	1/Quarter	Instantaneous	Quarterly	Quarterly Average
Specific Conductivity µmhos @ 25°C	FXC-1	1/Quarter	Grab	Quarterly	Quarterly Average
Nitrate + Nitrite (as N), mg/L	FXC-1	1/Quarter	Grab	Quarterly	Daily Maximum
Escherichia Coli, <1 CFU/100mL	FXC-2	1/Semi-annual	Grab	Semi-annually	Daily Maximum
Static Water Level (SWL), ft below top of casing	FXC-3	1/Quarter	Instantaneous	Quarterly	Quarterly Average
Nitrate + Nitrite (as N), mg/L	FXC-3	1/Quarter	Grab	Quarterly	Daily Maximum
Chloride (as Cl), mg/L	FXC-3	1/Quarter	Grab	Quarterly	Quarterly Average

6. Recommendations

This system uses individual 1500-gallon septic tanks for each residence as the start of primary treatment. It is highly recommended that each tank is pumped at least every 3 years. Pumping records must be maintained by the operator to prove proper maintenance of the system. During our site visit Rick Barnwell (Fox Crossing Wastewater Operator) indicated that there is a system in place to have a third of the tanks pumped each year, thus maintaining the three-year cycle.

7. Operator Training Opportunities

Website for Montana Environmental Training Center:
https://www.msun.edu/grants/metc/training.asp

Montana Water School is an excellent training for Operators. This year's Fall Conference will be held in Bozeman, October 9-11. Registration form available at:
https://www.msun.edu/grants/metc/documents/FS_18_Brochure-ParticipantRegistration.pdf

8. Contact Information – DEQ

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